

# Goddard Procedures and Guidelines

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## **PREFACE**

### **P.1 PURPOSE**

This document describes the Goddard Space Flight Center (GSFC) Radiation Protection Program for ionizing radiation. It contains administrative direction and guidance on organizational and procedural requirements of the program. It further provides radiation protection information to ensure that necessary radiation exposure will be kept As Low As Reasonably Achievable (ALARA).

Goddard's Radiation Protection Program operates in compliance with two Byproduct Materials Licenses issued by the Nuclear Regulatory Commission.

### **P.2 APPLICABILITY**

These procedures and guidelines are applicable to all GSFC personnel, facilities, and activities, including all permanent and temporary sites. These procedures also apply to all GSFC tenant organizations, contractors, grantees, clubs and other persons operating under a GSFC license or on GSFC property as required by law and as directed by contractual, grant, and agreement documents. This document applies only to ionizing radiation. Other types of radiation are covered in other documents.

### **P.3 AUTHORITY**

- a. U.S. Nuclear Regulatory Commission (NRC) Byproduct Materials Licenses 19-05748-02 and 19-05748-03
- b. [NPD 1800.2](#), NASA Occupational Health Program

### **P.4 REFERENCES**

- a. [NPG 1800.1](#), NASA Occupational Health Program Procedures
- b. [NPG 8715.3](#), NASA Safety Manual
- c. [GPG 1410.2](#), Configuration Management
- d. [GPG 3410.2](#), Employee Training
- e. [GPG 5340.2](#), Control of Nonconforming Product
- f. [GPG 6400.1](#), Logistics Support
- g. [Title 10 Code of Federal Regulations Part 20 \(10 CFR 20\)](#)
- h. U.S. NRC Form 3, Notice to Employees
- i. NRC NUREG-1556 Vol. 3, Consolidated Guidance About Materials License, Applications for Sealed Source and Device Evaluation and Registration
- j. NRC NUREG-1556 Vol. 11, Consolidated Guidance About Materials License, Program-Specific Guidance About Licenses of Broad Scope
- k. [GSFC Form 20-4](#), Transfer/Shipping Request
- l. [GSFC Form 23-6I](#), Request For Radiation Safety Committee Action - Ionizing Radiation Source Approval

- m. [GSFC Form 23-6ID](#), Request For Radiation Safety Committee Action - Ionizing Radiation Device Approval
- n. [GSFC Form 23-26](#), Radioactive Material Shipping and Receiving Record
- o. [GSFC Form 23-27](#), Health Physics Activity Report
- p. [GSFC Form 23-28I](#), Request For Radiation Safety Committee Action - Ionizing Radiation Source Questionnaire
- q. [GSFC Form 23-28ID](#), Request For Radiation Safety Committee Action - Ionizing Radiation Device Questionnaire
- r. [GSFC Form 23-35IP](#), Request For Radiation Safety Committee Action - Ionizing Radiation Source Personnel Approval
- s. [GSFC Form 23-55](#), Radiation Protection Data and Procedures (RPDP) Template
- t. [GSFC Form 23-59](#), Initiator's Acquisition Checklist

## P.5 CANCELLATION

GHB 1860.1B, Radiation Protection - Ionizing Radiation

## P.6 SAFETY

Safety requirements and numerous safety-related procedures are identified throughout this document. Specific requirements applicable to procedures resulting from this GPG are described where appropriate.

## P.7 TRAINING

Training requirements are specified in Section 2.3.2. There is also a training requirement on GSFC Form 23-55.

## P.8 RECORDS

Record Title	Para. Ref.	Record Custodian	Retention/Schedule
Source Records	P.10.f App A(5)	Radiation Protection Officer (RPO) keeps original; users maintain duplicate sets.	NASA Records Retention Schedule (NRRS) 8-39 Destroy when 75 years old.
GSFC Form 23-6I (Approved)	2.2.1 2.2.4.d 2.2.6 2.3.6.2 3.5.2	RPO keeps original; users maintain duplicate sets.	NRRS 8-38 Transfer to Federal Records Center when 6 years old. Destroy when 75 years old.
GSFC Form 23-6ID (Approved)	2.2.1	RPO keeps original; users maintain duplicate sets.	NRRS 8-38
GSFC Form 23-26	3.5	RPO keeps original; users maintain duplicate sets.	NRRS 8-38
GSFC Form 23-27	2.2.1.e 2.2.4.b 3.5	RPO	NRRS 8-38

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Record Title	Para. Ref.	Record Custodian	Retention/Schedule
GSFC Form 23-28I (Approved)	2.2.1 2.2.3 2.3.6.2	RPO	NRRS 8-38
GSFC Form 23-28ID (Approved)	2.2.1 2.2.3	RPO	NRRS 8-38
GSFC Form 23-35IP (Approved)	2.2.2 2.3.6.2	RPO keeps original; users maintain duplicate sets.	NRRS 1-130 Keep records for 2 years. If employee does not wish to be renewed for the position at the end of the 2-year period, the record is removed and placed in an inactive file. Records are retained at GSFC until destroyed. Destroy when 75 years old.
GSFC Form 23-55 RPDP	2.2.7 2.3.6.2	RPO keeps original; users maintain duplicate sets.	NRRS 8-38
Radiation Safety Operating Procedures	2.3.5 3.2.3 3.3.4	RPO keeps original; users maintain duplicate sets.	NRRS 8-38
Records associated with NRC licenses	2.1.1	RPO	NRRS 8-40 Destroy 10 years after expiration or renewal of license, provided all procured material has been disposed of.
Records associated with SSRB review of non-NRC approved sources	App. A	RPO keeps original; users maintain duplicate sets.	NRRS 8-38
Records of personnel experience and training	2.3.3	Supervisors	NRRS 1-130
Records of inspections and evaluations of facilities, equipment, location, and inventory	2.2.1.e 2.3.4 3.1.1 3.4.1	RPO or designee	NRRS 8-38
Records of equipment and facilities, including model numbers, serial numbers, and calibration requirements	2.2.1.c 2.3.5	User organization, as part of their Radiation Safety Operating procedures	NRRS 8-38
Safety Analysis Reports	2.2.1.f	RPO	NRRS 8-38
Reports of violations, contamination, decontamination, etc.	3.2	RPO	NRRS 8-38
Radiation monitoring records (dosimeters, etc., including levels, names, locations, etc.)	3.3.1	RPO	Handle as permanent pending retention approval
Records of shipments and transfers of radioactive materials	3.5	RPO	NRRS 8-39

CHECK THE GSFC DIRECTIVES MANAGEMENT SYSTEM AT  
<http://gdms.gsfc.nasa.gov/gdms> TO VERIFY THAT THIS IS THE CORRECT VERSION PRIOR TO USE.

## P.9 METRICS

- a. Number of harmful employee exposures
- b. Number of emergency responses to accidental, acute exposure
- c. Number of hazard-control measures initiated
- d. Number and cause(s) of procedural violations

## P.10 DEFINITIONS

- a. **Ancillary Personnel** – any persons who have unrestricted access to areas where radioactive materials are stored and/or used, including any persons involved in maintenance and janitorial duties in radiation areas.
- b. **Custodians** – any user who has been designated by the appropriate management and approved by the Radiation Safety Committee (RSC) to assume the responsibility of accountability for specific sources of ionizing radiation.
- c. **Device** – any piece of equipment that produces ionizing radiation.
- d. **Ionizing Radiation** – radiation that has sufficient energy to remove electrons from atoms.
- e. **Source** – any material that produces ionizing radiation. Sources are either licensed or unlicensed, as described in Section 2.1.
- f. **Source Record** – all records associated with a given ionizing radiation source, including the records from the supplier and all subsequent records.
- g. **User Organization** – the organization that is using a source or device, and that ensures requirements are met.
- h. **User** – any employee or contractor who has been approved by the RSC to use specific sources of ionizing radiation or devices for specific purposes and at specific locations.

## **PROCEDURES**

### **1. RESPONSIBILITIES**

#### **1.1 Management**

GSFC line management has primary responsibility for the radiological safety of personnel working under their jurisdiction and for designating users and custodians of sources of ionizing radiation. Line managers shall ensure that radiation sources are used only by individuals approved by the RSC and that all procedures and requirements are met.

#### **1.2 Safety and Environmental Branch (S&EB)**

The S&EB is responsible for radiation protection at GSFC and shall support all GSFC organizations in matters involving ionizing radiation, including the RSC.

#### **1.3 Radiation Safety Committee (RSC)**

The RSC is responsible to the Safety Management Council for overseeing development, direction and implementation of the GSFC Radiation Protection Program. The RSC:

- a. Is chaired by an individual designated by the Head, S&EB.
- b. Meets as often as necessary to accomplish its responsibilities, not less than quarterly.
- c. Ensures that ionizing and non-ionizing radiation used at GSFC or under GSFC programs is managed so as to minimize the health and safety risks.
- d. Ensures compliance with GSFC requirements, NRC requirements, and other Federal regulations, professional standards, and sound health physics practices.
- e. Approves radiation operations and, if necessary, prescribes conditions and requirements to minimize radiation hazards to keep dose rates ALARA.
- f. Establishes the qualifications of users and custodians.
- g. Approves users, custodians, and uses of ionizing radiation.

#### **1.4 Radiation Protection Officer (RPO)**

The RPO is appointed by the Head, S&EB, and will provide for the inspection of radiation use and storage areas, perform audits of source records, and evaluate usage and training programs to ensure compliance with RSC requirements. The RPO will maintain appropriate records of these inspections and evaluations. The RPO is the primary point of contact for all radiation safety emergencies.

#### **1.5 Sealed Source Review Board (SSRB)**

The SSRB is appointed by the RSC to review and approve sealed sources that do not have NRC approval. See Appendix A for SSRB procedures and requirements.

## 1.6 Custodian

The custodian is responsible for accountability for specific sources of ionizing radiation, and shall ensure that only approved users use the sources.

## 1.7 Employees

All employees involved in radiological activities are responsible for knowing and observing GSFC radiological safety regulations. They must immediately report to their supervisor all unsafe conditions or operations involving radiation sources or devices. They are also free to raise safety concerns to anyone including the RPO and the U.S. NRC.

## 2. ADMINISTRATIVE PROCEDURES

This section defines the approval requirements associated with radiation sources and devices, and describes the procedures and guidelines that ensure that work with ionizing radiation sources and/or devices is performed with due regard for radiological safety.

### 2.1 Licensing by the NRC

#### 2.1.1 Licensed Sources

GSFC is authorized to possess, use, and transfer byproduct, source, and special nuclear material under specific and general licenses issued by the NRC. The S&EB maintains the records associated with licenses.

#### 2.1.2 Non-licensed Sources

The NRC does not license x-ray-producing machines, particle accelerators, accelerator-produced radioisotopes, or radium and its daughter products. However, the RSC controls possession and use of these sources of ionizing radiation at GSFC, which are also subject to GSFC and Federal regulations on radiological safety. Combined exposure from licensed and non-licensed sources must not exceed NRC limits stated in Title 10 Code of Federal Regulations, Part 20 (10 CFR 20).

### 2.2 Approval Requirements for Uses, Users, and Custodians of Ionizing Radiation Sources

All Uses, Users, and Custodians of Ionizing Radiation Sources, including the radiation sources themselves, require approval by the RSC. This section explains the processes necessary to gain these approvals. They are:

- a. Section 2.2.1 Approval for Use of Sources or Devices
- b. Section 2.2.2 Approval of Users and Custodians
- c. Section 2.2.3 Approval of Radiation Sources or Devices
- d. Section 2.2.4 Conditions for Continuation or Change of Approval



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- e. Section 2.2.5 Approval of Purchase Orders
- f. Section 2.2.6 Approval for Onsite Movement of Sources
- g. Section 2.7.7 Approval for Use Offsite and for Launch

### 2.2.1 Approval for Use of Sources or Devices

Requests for approval to use ionizing radiation sources are initiated by submitting a GSFC Form 23-6I and a GSFC Form 23-28I to the S&EB. Requests for approval to use ionizing radiation emitting devices (such as x-ray machines, accelerators, scanning electron microscopes, etc.) are initiated by submitting GSFC Forms 23-6ID and 23-28ID to the S&EB.

Applications for use must be received by the S&EB at least 2 weeks prior to the need date to guarantee processing. Complicated projects, extremely hazardous operations, offsite activities and flight activities should be coordinated with the RPO in early planning stages to ensure that there is no impact to mission schedules.

Approvals are only valid for a maximum of 2 years and may contain conditions that restrict the use of the material for specific purposes at GSFC and GSFC-approved locations.

The procedure for sources is described below. For devices, use GSFC Forms 23-28ID and GSFC Form 23-6ID.

- a. The originator first prepares GSFC Form 23-28I describing the radiation sources involved and identifying their nominal strengths. For new sources to be procured see section 2.2.5.
- b. Using a GSFC Form 23-6I, the originator describes the intended use of the source and shows that it can be used safely. When the intended use is very complex or may result in a greater risk than normally associated with Type I or II, all such sources will be considered Type III. See Section 2.3.1 for Type Classification.
- c. The originator completes and submits the GSFC Form 23-6I to S&EB, along with documented safety procedures (see Section 2.3.5), showing that the source can be properly used, stored, disposed, and transferred with minimum exposure to personnel or damage to property. All operations must be in compliance with GSFC and other applicable regulations. The location and availability of proper equipment (including model numbers, serial numbers and calibration requirements as applicable) and facilities should be included in the procedures.
- d. The applicant must be approved by the S&EB to use the source for the specific purposes (qualifications are discussed in paragraph 2.2.2). Additional training may be required before approval is granted.
- e. When the S&EB receives the request, it will perform a health physics evaluation to determine the adequacy of the equipment, facilities, and location for the particular use of the radiation source. Operating procedures and source handling techniques will be discussed and evaluated, including final source disposal options. On the basis of the evaluation, the S&EB may impose additional conditions to ensure safe operation. Any additional conditions or explanation of non-approval will accompany the

request application. Documentation of this activity is done using the GSFC Form 23-27 with appropriate attachments.

f. In some cases, the S&EB may require the applicant to submit a safety analysis that indicates probability of a serious incident, its consequences, and mitigation. The S&EB will determine the requirements on a case-by-case basis.

g. The RSC will approve or disapprove the request for use of ionizing radiation sources and/or devices, and notify the applicant by providing a copy of the approved or disapproved GSFC Form 23-6I or GSFC Form 23-6ID. The RSC may also impose additional requirements.

### **2.2.2 Application for Approval of Users and Custodians**

To become an approved user or approved custodian, an applicant must submit GSFC Form 23-35IP to the appropriate branch head (or higher authority) for concurrence. If satisfied with the application, the branch head (or higher) will forward the request to the S&EB. The form requires certification that the applicant has the education, training, and experience necessary for the proper use of sources of ionizing radiation for the specific purpose and specific location requested. See Section 2.3.2 for training requirements.

Civil service and contract employees may be approved as users or custodians of sources of ionizing radiation at GSFC or GSFC-approved locations. Contractor and other personnel operating offsite under GSFC license are subject to all provisions of Goddard's Radiation Protection Program. Contractors operating under a self-license and on contractor-owned facilities shall submit a copy of the applicable licenses and a full description of their programs to the RSC. The RSC will review the submissions and establish any necessary conditions or restrictions as set forth in this directive.

Proposed users will only be allowed to work under the supervision of a currently approved user until formal RSC approval has been granted. RSC approval must be renewed every 2 years.

### **2.2.3 Requests for Approval of Radiation Sources or Devices**

For sources, an applicant will submit GSFC Form 23-28I. For devices, an applicant will submit GSFC Form 23-28ID. The request will be submitted to the appropriate branch head (or higher authority) for concurrence. If satisfied with the application, the branch head (or higher) forwards the request to the S&EB.

### **2.2.4 Conditions for Continuation or Change of Approval**

a. The S&EB must approve, in advance, any change of use, user, or location, and may impose additional conditions before approval.

b. The S&EB will carry out routine health physics surveys to ensure proper handling of the radiation sources. These surveys will be documented on GSFC Form 23-27.

- c. All approvals must be renewed every 2 years.
- d. An approved user who needs to use radiation sources in a manner other than that already approved must submit a new GSFC Form 23-6I, describing the new use, through the proper supervisor. The supervisor, if satisfied with the application, forwards the request to the S&EB for completion of the review process.
- e. All approvals are subject to conditions of the NRC licenses held by GSFC and the conditions imposed by the RSC. Violations of the approved conditions regarding uses, users, or location may result in revocation of the approval.

### **2.2.5 Requirements for Purchase Requests**

All purchase requests issued by GSFC for radiation sources or devices require RPO approval. Initiators of purchase requests shall ensure that this approval is obtained before processing of the purchase. A unique GSFC source serial number shall be obtained from the RPO, and shall be designated on the purchase request to be placed on the source during manufacture. This number is required on other approval forms. Such approvals can be obtained simultaneously with other approvals, such as approval for use or approval of sources or devices.

If the purchase request is other than a small purchase, initiators shall also submit GSFC Form 23-59.

### **2.2.6 Approval for Onsite Movement of Sources**

GSFC Form 23-6I must be submitted for all actions involving movement of sources on Center (loans, shipments, transfers, different uses, etc.). This requirement does not apply to devices. See Section 3.5 for additional information.

### **2.2.7 Approval for Use Offsite and for Launch**

Approval from the RSC must be obtained to use GSFC licensed material at a temporary job site. This will be in the form of an approved Radiation Protection Data and Procedures (RPDP) document. The RPDP is described in more detail in Section 2.3.6.2, and is prepared using the RPDP template (GSFC Form 23-55). The user organization is responsible for generating this document, and requires approval by the RSC at least 6 months prior to offsite material use. The RPDP will be controlled in accordance with GPG 1410.2.

## **2.3 Guidelines for Use of Radiation Sources or Devices**

### **2.3.1 Categories of sources**

All ionizing radiation sources will be categorized by the RPO based on unsealed sources having a comparison hazard based on  $^{239}\text{Pu}$  (measured in body burdens), and sealed sources having a comparison hazard based on  $^{60}\text{Co}$  (measured in dose rates). For example: Type I sources would allow a maximum of 250 body burdens and up to 150 millirem per hour at one foot.

The categories are described below:

CHECK THE GSFC DIRECTIVES MANAGEMENT SYSTEM AT  
<http://gdms.gsfc.nasa.gov/gdms> TO VERIFY THAT THIS IS THE CORRECT VERSION PRIOR TO USE.

- a. Unclassified - Less than 185 Becquerels (0.005 microcuries); high voltage equipment operating below 15 kV; high voltage equipment emitting x-rays not exceeding 0.5 milliRoentgens per hour (mR/hr) at 5 cm from any accessible surface.
- b. Type I – 0.005 to 10 microcuries (185 to  $3.7 \times 10^5$  Becquerels) unsealed and 0.005 microcuries to 10 millicuries (185 to  $3.7 \times 10^8$  Becquerels) sealed sources; sources incorporated in devices used, not directly, but as a part of an instrument or to produce a particular effect (i.e., gas chromatograph units, static-elimination devices, light sources, vacuum gauges).
- c. Type II – 10 microcuries to 10 millicuries ( $3.7 \times 10^5$  to  $3.7 \times 10^8$  Becquerels) unsealed and 10 to 100 millicuries ( $3.7 \times 10^8$  to  $3.7 \times 10^9$  Becquerels) sealed sources; x-ray machines other than those previously mentioned.
- d. Type III – Radionuclides of activity greater than those in Type II; also accelerators, reactors, and x-ray machines with power output greater than 500 kVp.

### 2.3.2 Personnel Training Requirements

#### 2.3.2

Minimum training required for personnel using the above categories is shown in the table below. Course descriptions follow the table.

Source Classification	Course A*	Course B*	Course C**	Course D*
Unclassified	-	-	-	-
Type I	Yes	-	-	-
Type II	Yes	Yes	-	-
Type III	Yes	Yes	Yes	-
Ancillary Personnel (Not using sources)	-	-	-	Yes

\* Provided by S&EB.

\*\*Provided by user directorate as combination of On-the-Job Training (see GPG 3410.2) and/or formal course.

Course training materials and requirements are maintained current by the RPO.

#### 2.3.2.1 Course A requirements:

- a. Read and understand this directive
- b. Understand security requirements involving ionizing radiation

- c. Discuss user responsibilities
  - (1) ALARA principle
  - (2) GSFC administrative procedures and NRC requirements
  - (3) Wear and care of radiation dosimeters
- d. Records

#### **2.3.2.2 Course B requirements**

- a. Course A requirements fulfilled
- b. Qualifications of custodians and users
- c. Methods of handling approval procedures
- d. Radiological safety during source use and handling
- e. NRC license requirements
- f. RSC requirements
- g. Inspection and survey requirements
- h. Launch and offsite operations and requirements (if applicable)
- i. Basic radiation mathematics
- j. Radiation exposure effects
- k. Radiation exposure control methods
- l. Dealing with violations of rules, regulations, and requirements
- m. Emergency procedures

#### **2.3.2.3 Course C requirements**

- a. Course B requirements fulfilled
- b. Radiation interaction with matter
- c. Advanced radiation mathematics
- d. Dose rate measurements
- e. Radiation hazard zone determination
- f. Neutrons - Detection and Measurement.
- g. X-ray producing devices and exposure control
- h. Accelerator operations and safety considerations (if applicable)
- i. Detailed NRC license review
- j. Ion chamber theory
- k. Scintillation counters

#### **2.3.2.4 Course D Requirements**

The extent of instructions for ancillary personnel is based on the potential radiological health protection problems in the areas of work or access. These personnel must:

- a. Be familiar with the types of radioactive materials to be used, stored, or transferred in the area.
- b. Be familiar with the health problems associated with exposure to the radioactive materials in the area.
- c. Know how to minimize exposure to the radioactive materials or radiation.
- d. Know what to do if an alarm sounds in the area.

- e. Be informed of the availability of personal monitoring devices.
- f. Read and understand NRC Form 3, which explains general employee instructions and protection.

### 2.3.3 Personnel Experience Requirements

Experience in working with hazardous radiation sources is crucial. A person must have previous experience in handling or operating radiation sources when using sources. Experience for this requirement includes that obtained from universities, former employment, and work supervised by an approved person. The following table shows the minimum experience necessary to work with radiation sources:

Source Type	Experience Required*
Unclassified	None
Type I	None
Type II	1 week
Type III	3 months
*Other requirements may be substituted for experience as determined appropriate by the RSC.	

Supervisors are responsible for keeping records of this experience.

### 2.3.4 Inspection and Inventory Requirements

Facility inspections, equipment inspections, and source storage location inspections will be performed by RPO (or designee) to ensure compliance with the approved GSFC 23-6I and/or 23-6ID.

### 2.3.5 Radiation Safety Operating Procedures

The user organization shall develop documented safe operating procedures with regard to the use of the radiation sources. These procedures shall describe the control methods to be used in each application. Requirements differ, depending on the type of source(s) and the operation:

Source Type	Procedures Required (Minimum)
Unclassified	Storage and security aspects
Type I	Clear brief description of source use, storage and security aspects, and final disposition
Type II	Detailed description of source use, storage, security, and final disposition
Type III	Clear, detailed operating procedure for all phases of the operation including use, handling, storage, security, and final disposition

In addition to the items described in the above table, the following requirements shall be addressed. This is not an all-inclusive list, and further items and controls may be necessary depending on the particular use.

- a. State that only persons authorized by the RSC may use the sources.
- b. Specify that no eating, drinking, or smoking is permitted in the source use or storage area, and that storage of food, drinks, or personal effects is not allowed in these areas.
- c. Specify necessary personal protective equipment, e.g., gloves, lab coats, safety glasses, respirators, etc.
- d. State personnel monitoring requirements, i.e., Whole Body Thermoluminescent Dosimeter, extremity badge (wrist, ring), etc.
- e. Specify storage and security methods.
- f. Specify that the source shall be secured from unauthorized personnel whenever it is not under the immediate control of an authorized user.
- g. Specify any special area monitoring, i.e., procedures for checking for area or personnel contamination when required.
- h. Describe emergency procedures, such as in the case of fire, contamination of source by chemicals, a spill of liquid sources, release of gaseous sources, etc.
- i. Specify methods for disposal of radioactive waste, if applicable.
- j. Identify specific equipment and facilities, including equipment model numbers, serial numbers, and calibration requirements.
- k. Specify required warning signs and labels.

These procedures shall be issued as Controlled Documents under configuration control (see GPG 1410.2), and shall require approval by the S&EB. In addition, they are subject to review every 2 years by the S&EB or when the procedure requires modification. These documents will be issued with a 2-year expiration date.

### **2.3.6 Use of Sources in Launch Operations or Other Offsite Functions**

**2.3.6.1 Radioactive Materials Launch List.** In coordination with GSFC flight projects, the S&EB will compile and submit to NASA Headquarters a list of launches involving radioactive material. GSFC launch and project organizations must furnish the S&EB with the launch and source information described in NPG 8715.3, Chapter 5, at least 6 months prior to the scheduled launch. The S&EB will prepare its report to NASA Headquarters in accordance with established procedures. Coordination should start with the earliest knowledge of radioactive material involvement.

**2.3.6.2 Procedures for Approval for Offsite Operations, Including Launches.** Below are the procedures to apply for approval to use or launch radioactive material at locations other than GSFC/Greenbelt or Wallops. This coordination should occur early enough to ensure timely receipt of range approvals for these materials, and conformity with GSFC procedural and licensing requirements. Timely submittal of these documents is recommended because some ranges require as much as 90 days prior notice of intent to use radiation sources. International programs can also be time-consuming, and additional time may be necessary for correction of procedural discrepancies. Coordination with the



S&EB should start with the earliest knowledge of involvement of radioactive material(s). Similarly, if international shipments are involved, coordination of International Traffic in Arms requirements with the GSFC transportation officer should occur very early. See Section 3.5.1.

The project manager shall ensure that the user initiates a RPDP document to use or launch radioactive material at/from an offsite location, and submits the RPDP to the RPO, along with GSFC Form 23-6I, GSFC Form 23-28I, and GSFC Form 23-35IP. The RPO will then submit an appropriate usage request, in accordance with the usage site's requirements, to the appropriate range or site, which shall include the following information:

- a. Listing and descriptions of all radioactive sources to be delivered to the site, including the associated experiment, whether for ground or in-flight use, and description of activity and date of activity.
- b. Any available diagram(s) of locations of experiments containing radioactive materials on the spacecraft, sounding rocket, etc.
- c. A list of radiological monitoring instrumentation (including calibration dates) and emergency equipment to be made available at the site.
- d. Descriptions of types of shielding for radioactive materials.
- e. Applicable licenses for handling the radioactive material.
- f. Summary of the method of use, storage, monitoring requirements, and precautions to be observed.
- g. Description of the shipping plan that details the receipt and return of the sources from the use site.

**2.3.6.3 Qualification of Sources Used in a Vacuum.** All sources to be launched, and any source(s) used in thermal vacuum chambers at GSFC during integration of payload(s), will be thermal-vacuum qualified. Qualification will be obtained as described in paragraph 3.4.3.

**2.3.6.4 Shipments.** All shipments of radioactive material related to offsite locations shall be in accordance with paragraph 3.5.1.

### 3. RADIATION CONTROL PROGRAM

GSFC conducts a comprehensive control program to ensure that radiation sources are safely used, thereby preventing unnecessary exposure to personnel. The program is designed to ensure compliance with GSFC guidelines and NRC regulations.

#### 3.1 S&EB Surveys and Inspections

##### 3.1.1 Radiation Surveys

All areas where radioactive sources and/or devices are used or stored under GSFC licenses shall require S&EB approval before use (see Section 2.2), and shall be surveyed every 6 months thereafter to ensure that conditions and controls remain adequate. Radiation dose rate measurements and contamination checks are made to ensure the lowest practical radiation exposure level. As part of these surveys, the S&EB shall ensure that proper facilities and equipment are maintained to limit the potential radiation source hazard. The S&EB shall also ensure that appropriate storage containers, equipment, and security measures are provided for proper handling and to prevent unauthorized personnel from using radiation sources.



### 3.1.2 Contamination

Areas where radioactive materials are used or stored will be checked every 6 months to ensure that contamination does not exceed GSFC surface contamination limits. Appropriate air samples shall be taken during any operation where contamination could become airborne and possibly inhaled. Decontamination operations will be performed only by qualified S&EB personnel or under their direct supervision.

## 3.2 Problem Reporting

### 3.2.1 Violations

Any unusual conditions or violations detected during surveys or inspections shall be reported in writing to S&EB. S&EB will document the violation in the Nonconformance Reporting/ Corrective Action database in accordance with GPG 5340.2. The responsible manager and custodian must provide for followup action to correct the situation, and must inform the S&EB when corrective action is complete.

Any incident or operation suspected of causing unusual surface or air contamination shall be reported as an emergency as outlined in section 3.2.2.

### 3.2.2 Radiation Event Reporting and Investigation

In addition to the reporting required for mishaps, incidents, and close calls, all such events involving radioactive sources used under the Goddard Broadscope License shall be immediately reported to the radiation protection staff. The radiation protection staff will provide support to the user organization if a problem with source integrity is observed. The RPO will conduct an investigation and prepare a report to the RSC regarding failure of any committee-certified sealed source.

### 3.2.3 Emergencies

This GPG contains only general guidelines for dealing with emergency situations. Due to the many variations in laboratories, personnel, and programs, detailed specification of responses applicable to all emergency situations is extremely difficult. Specific emergency response plans are the responsibility of the users and must be developed in coordination with the S&EB and addressed in the organization's Radiation Safety Operating Procedures applicable to each area. When radiation safety problems arise, the senior individual immediately responsible for the operation must notify the S&EB. In an emergency, the following steps are to be taken:

- a. Leave the hazard area. All persons that were present at the time of the emergency, or that arrived after the emergency, must remain in the vicinity but at a safe distance unless they require medical treatment;

- b. Isolate the hazard, if possible (i.e., close doors and shut off ventilation);
- c. Warn others of the hazard;
- d. Immediately report the emergency to the center emergency operator by dialing 911 at Greenbelt, or 1333 at Wallops;
- e. Report events of the incident to the S&EB representative; and
- f. Obtain clearance from S&EB personnel before leaving the immediate vicinity.

### **3.3 Personnel Protection**

#### **3.3.1 Personnel Monitoring**

The S&EB issues radiation dosimeters as required by 10 CFR 20 for determining the amount of radiation exposure received by personnel. The S&EB will maintain a system for tracking the badges, and ensuring that dosimeters are exchanged on a routine basis. Additional monitoring shall also be performed as determined by the S&EB or the RSC. Operations may be monitored for a specified period of time to determine if there is a need for continuation of personnel monitoring.

- a. Dosimeters shall be worn on the front of the body, between the waist and the neck. Personnel leaving radiation control areas shall leave their dosimeters on a rack designated by the S&EB.
- b. Any individual not routinely monitored shall be issued a temporary dosimeter before they enter a 'Radiation Area' (see paragraph 4.2.1.c.). Supervisors will contact the S&EB to arrange for temporary dosimeter issue. The supervisor shall also ensure that employees are removed from the dosimetry program when they leave NASA service or are transferred out of the area.
- c. The S&EB shall notify the supervisor if any significant increase of radiation is found above background when personnel are monitored.
- d. The supervisor shall ensure any individual suspected of having received an overexposure does not resume radiation work until either the S&EB or the RSC has evaluated the suspected exposure. Overexposure is defined as a whole body radiation dose greater than 4 millisieverts (400 mRem) per 30 days.

#### **3.3.2 Radiation Safety Equipment**

**3.3.2.1 Facility Equipment.** The RSC shall require that special radiation safety equipment be installed when deemed necessary for personnel protection. Detectors, interlocks, glove boxes, fume hoods (with appropriate filters), remote control equipment, manipulators, tongs, etc. may be required for safe operations.

**3.3.2.2 Personal Protective Equipment (PPE).** When risk of contamination exists, the S&EB will require the use of PPE. PPE may include, but not be limited to, garments, safety glasses, and respirators.

### 3.3.2.3 Physical and Medical Examinations

Various examinations are provided for employees whose work may expose them to ionizing radiation. Employees may refuse these examinations, but failure to have the examinations could lead to the employees not being allowed to work with sources that produce these types of radiation.

The GSFC Medical Director, in accordance with NPG 1800.1, will determine the frequency and type of examinations. Medical restrictions and personal protective equipment may be required.

GSFC employees exposed to types of ionizing radiation that might affect the eyes (such as beta rays or soft x-ray) will be offered periodic eye examinations for cataracts or other lens opacities.

### 3.3.3 Use of Written Procedures

A written Radiation Safety Operating Procedure, as described in Section 2.3.5, shall be available at each source area. Custodians must ensure that sources are used only according to approved procedures. These procedures are subject to review every 2 years by the S&EB or when the procedure requires modification.

### 3.3.4 Other Considerations

The following general safety rules must be observed:

- a. Foods, beverages, and smoking materials are PROHIBITED in areas where radioactive materials are used or stored and the likelihood of radioactive contamination exists.
- b. Absolutely NO pipetting by mouth is allowed.
- c. Laboratory glassware used with radioactive materials MUST NOT leave the controlled area.
- d. After handling possible sources of contamination, personnel SHALL BE surveyed for contamination prior to leaving the controlled area.

## 3.4 Control of Radionuclide Sources

### 3.4.1 Inventories and Inspections

All radiation sources shall be subject to inspection and inventory as described in paragraph 2.3.4 and as required by license. The S&EB representative shall personally view the location of sources during inventory. The possible loss of any source shall be immediately reported to the S&EB. All transfers of sources shall be coordinated with and approved by the S&EB.

### 3.4.2 Leak Tests

Sealed radiation sources shall be subject to leak tests by the S&EB as determined necessary by good health physics practice, Sealed Source Registration Certificates, and in accordance with NUREG-1556,

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Vol. 11, Appendix T. Leak tests shall also be conducted whenever sources are transferred, shipped or received. If a source is being transferred onsite and has been leak tested within the past 90 days, the transfer leak test may be waived by the RPO.

### 3.4.3 Environmental Testing Certification

The S&EB shall ensure the stability of sources that are to be used in adverse conditions. This is to be accomplished by subjecting the source to expected conditions in a controlled situation in a vacuum chamber or other environment acceptable to the custodian and the RSC. The S&EB reserves the right to require independent certification of sources. Source design criteria (other than NRC-approved sealed sources) must be reviewed and approved by the SSRB prior to use (see Appendix A).

### 3.4.4 Disposal

Disposal of radioactive material and contaminated items shall be arranged by the RPO. When a source is no longer needed or begins to indicate leakage, the user shall contact the RPO to arrange for disposal. Independent disposal or transfer of radioactive materials is prohibited. Disposal restrictions apply to all radioactive materials including generally licensed items, regulatory-exempt items, and naturally occurring and accelerator-produced materials.

## 3.5 Shipping, Receiving, or Transfer

Regulations for shipping of radioactive sources are established by the Department of Transportation, the International Atomic Energy Agency, the International Air Transport Association, the Federal Aviation Administration, and the U.S. Coast Guard. Information on compliance requirements is available from the S&EB.

All shipments of radioactive material shall be coordinated through the S&EB. Users shall notify S&EB of any requirement for an incoming shipment, outgoing shipment, or onsite transfer sufficiently in advance to make the necessary arrangements. The S&EB shall keep records of all shipments and transfers of radioactive materials involved in GSFC operations. For each shipment, this shall include [GSFC Form 23-26](#), [GSFC Form 23-27](#), and a copy or reference to any applicable 20-4. The record copy of the 20-4 shall be kept as defined by GPG 6400.1.

### 3.5.1 Outgoing Shipments

Outgoing shipments of radioactive material shall be arranged through the S&EB. The S&EB ensures that all packaging of radioactive materials is done in the proper manner. Only those people specifically approved by the RSC shall package radioactive material for shipment.

For international shipments, the S&EB shall coordinate shipping activities with GSFC Transportation at the earliest opportunity. International shipments will also require one of the following documents prior to shipment:

- a. Written agreement of a company or organization licensed by the government of the foreign country to accept responsibility for the source(s) with copy of license;
- b. Written authorization from a qualified government official of the foreign country authorizing import and use of the source(s);
- c. Written authorization from the NASA Headquarters International Affairs Division for import and use of the source(s) in the foreign country; or
- d. Written authorization from the U.S. Department of State for import and use of the source(s) in the foreign country.

### 3.5.2 Incoming Shipments

Incoming shipments of radioactive material shall be received and opened only by the S&EB or specifically approved persons as designated by the RSC. All incoming shipments must be leak tested prior to delivery to the custodian. A GSFC Form 23-6I must be on file for all ionizing radiation sources. All shipments of radioactive material shall be coordinated through the S&EB.

### 3.5.3 Internal Transfers at the GSFC

Internal transfers at GSFC shall be arranged through the S&EB.

## 4. RADIATION PROTECTION GUIDELINES AND LIMITS

### 4.1 Exposure Limits for Radiation Workers

#### 4.1.1 Limits for External Radiation

Exposure to External Radiation shall not exceed the limits specified in 10 CFR 20, Subpart C:

Parameter	Dose Limit per Calendar Year	
	Rems	Sieverts
Total Effective Dose Equivalent, <i>or</i>	5.0	0.05
Sum of deep-dose equivalent <i>or</i> extremity shallow dose equivalent	50	0.5
Eye dose equivalent	15	0.15

#### 4.1.2 Limits for Airborne Concentrations of Radioactive Materials

Guidelines in 10 CFR 20, Subpart H will be followed to limit internal exposure in restricted areas.

**4.1.3 Limits for Skin Contamination.** The table below lists permissible limits for skin contamination. If these levels are thought to be exceeded, the S&EB must be notified.

MAXIMUM PERMISSIBLE CONTAMINATION LEVELS				
Location	Alpha (dpm/100cm <sup>2</sup> )	Beta-Gamma measured at 1 cm		Transferrable (Smear) Alpha/Beta/Gamma
		mRem/hr	microSieverts/hr	
Body	150	<0.06	<0.6	None Detectable
Hands	150	<0.10	<1.0	None Detectable

**4.1.4 Exposure Limits for “Declared Pregnant” Radiation Workers.** Limits for women who have declared their pregnancy in writing to the RPO are established in 10 CFR 20.1208. Instructions for declaring a pregnancy can be found in the Pregnancy Declaration Letter, available on the GSFC Safety 1st Web site. Information concerning radiation exposure to the fetus/embryo can be found in “Questions & Answers Concerning Prenatal Radiation Exposure.” Both may be found at <http://safety1st.gsfc.nasa.gov/rad.html>.

#### 4.1.5 Exposure Limits For Non-Radiation Workers

Limits for individual members of the public shall not exceed the limits specified in 10 CFR 20, Subpart D.

## 4.2 Exposure Limits for Radiation Control Areas

### 4.2.1 Types of Radiation Control Areas

- Unrestricted Area** - An area not classified as a radiation control area.
- Radioactive Materials Area** - An area or room in which radioactive material is used or stored in quantities specified in 10 CFR 20.1902(e).
- Radiation Area** - Areas accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 5.0 millirem (0.05 milliSievert [mSv]) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- High Radiation Area** - Areas accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 100 millirem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.
- Airborne Radioactivity Area** – An area where the radiation sources are airborne, such as a radioactive powder.

### 4.2.2 Exposure Limits

**4.2.2.1 Radiation Limits.** Radiation levels must not exceed 2 mRem/hr (20 microSieverts/hr) or exceed a general public dose limit of 100 mRem (1 mSv) in a year.

**4.2.2.2 Airborne Contamination Limits.** The concentration of airborne radioactive material in an occupied radiation control area or an unrestricted area may not exceed the amount specified in 10 CFR 20, Appendix B, Table 1. The concentration of airborne radioactive material in an unoccupied radiation control area (e.g., a glove box) is limited only by radiation caused by such airborne activity outside of that area.

**4.2.2.3 Surface Contamination Limits.** Surface contamination limits for radiation control areas are described in the table below. Surface contamination limits for unrestricted areas are limited to the levels identified as “clean.”

PERMISSIBLE SURFACE CONTAMINATION LIMITS			
Control Classification	Removable Contamination Limits (dpm/100 cm <sup>2</sup> )		Minimum Control Required
	Alpha	Beta-Gamma	
Clean	<20	<200	None
Contaminated	>20 <1000	>200 <10,000	Lab coat and gloves required. Personnel may leave the area and equipment may be removed only after monitoring shows them to be clean. Radiation control area signs will indicate that the area is contaminated and list requirements for entry.
Contaminated	>1000 <9,999	>10,000 <100,000	Coveralls, gloves, and shoe covers are required. Personnel may leave area only after monitoring shows them to be clean. Equipment may be removed from area only after monitoring by the S&EB. Radiation control area signs will indicate area is contaminated and list requirements for entry.
Contaminated	>9,999	>100,000	Requires specific operating procedures approved by the RSC.

**NOTICE – ALL OPERATIONS SHALL FOLLOW ALARA!**

#### 4.2.3 Leakage/Contamination Levels for Sealed Sources

The table below lists the sealed source leakage/ contamination limits.

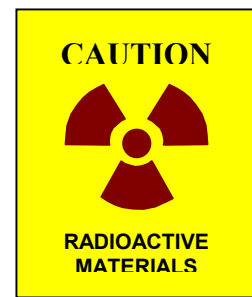
SEALED SOURCE LEAKAGE LIMITS				
Restriction of Use	Maximum Amount of Leakage or Removable Contamination			
	<i>Alpha</i>		<i>Beta/Gamma</i>	
	<i>microcuries</i>	<i>Becquerels</i>	<i>microcuries</i>	<i>Becquerels</i>
None	$<1 \times 10^{-5}$	$<0.37$	$<1 \times 10^{-4}$	$<3.7$
*Conditional use (i.e., use of enclosure and strict contamination controls)	$\geq 1 \times 10^{-5}$ $< 5 \times 10^{-3}$	$\geq 0.37$ $< 185$	$\geq 1 \times 10^{-4}$ $< 5 \times 10^{-3}$	$\geq 3.7$ $< 185$
Disposal as radioactive waste or return to manufacturer	$\geq 5 \times 10^{-3}$	$\geq 185$	$\geq 5 \times 10^{-3}$	$\geq 185$

\* Handled and used as “unsealed source” until experiment is concluded with ultimate disposal as radioactive waste.

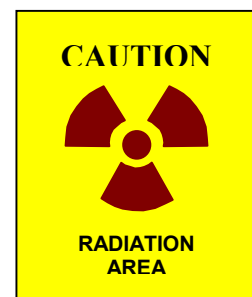
#### 4.2.4 Signs for Radiation Control Areas

Standard magenta and yellow signs bearing the radiation symbol and an appropriate legend will be placed in the following potential hazard areas. Waivers in particular cases may be granted by the S&EB.

- a. Radioactive Materials Area - The following sign must be posted in each area or room where used or stored radioactive material is ten times greater (or its equivalent) than the amount exempted in Appendix C of 10 CFR 20:



- b. Radiation Area - The following sign must be posted in areas where radiation levels are high enough to result in an individual receiving a dose equivalent in excess of 5 millirem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

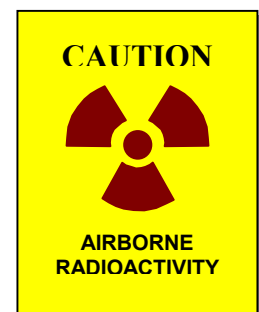




c. High Radiation Area - The following sign must be posted in each accessible area, accessible to individuals, where radiation levels could result in an individual receiving a dose equivalent in excess of 100 millirem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.



d. Airborne Radioactivity Area - The following sign must be posted in any area in which airborne radioactivity exceeds the limits specified in 10 CFR 20, Appendix B, Table 1.



e. Contaminated Area - The following sign must be posted in any area in which removable contamination exceeds the "clean" limits of the table shown in paragraph 4.2.2.3:



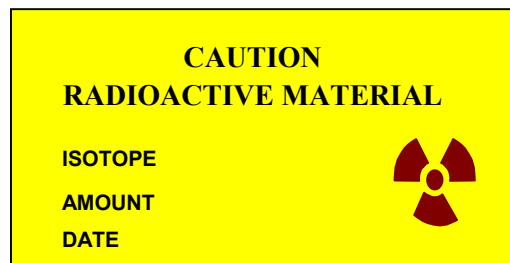
f. X-rays - The following sign must be posted in each room or area in which an x-ray machine or an x-ray producing device is used:



g. Additional Inserts - Other inserts are available from the S&EB and can be used in combination with the basic signs previously described. Some examples are presented below:



**4.2.5 Labels for Radiation Sources and/or their Containers.** All sources of ionizing radiation and/or their containers must be clearly labeled with the standard radiation symbol and appropriate information. The S&EB will provide the tags, and only S&EB personnel may remove the tags. The total activity of sources in containers should be listed, by radionuclide, on the following label:



## **APPENDIX A: SSRB Procedures For Review of Non-Standard Sealed Sources**

Research and development programs often require use of non-standard radiation sources or sources of foreign ownership. Some of these sources may not be registered by the Nuclear Regulatory Commission. When this type of source must be obtained and possessed under the Goddard NRC Broadscope Byproduct Materials License, the SSRB is convened to review and authorize its use.

### **A.1 Composition of the SSRB**

The Board is comprised of designated representatives from the RSC, S&EB Radiation Protection staff, and the Materials Engineering Branch. When required, representatives from the Office of Systems Safety and Mission Assurance or the Applied Engineering and Technology Directorate will be selected. The SSRB is chaired by the RSC chairperson or designee.

### **A.2 User Responsibilities: Principal Investigator or Project Manager**

- a. The owner/user (or individual designated to do so by the using organization) shall ensure that all required information is provided for review by the Board. When requested by the SSRB, they shall attend the Board meeting.
- b. The principal investigator or project manager is responsible for proper submission of the information and other support to the SSRB, and for maintaining sources and their uses in accordance with Board approvals.

### **A.3 Review Process**

The Board will review all appropriate documents, engineering specifications, drawings and other such information as described below.

The basic construction of the source will be evaluated to ensure that the radioactive material will not be dispersed when subjected to environmental stresses during use. Materials used in its construction will be evaluated to ensure compatibility with handling devices, extended storage, and packaging used for transportation. When required by the Board, prototypes of the source housing may be required for destructive testing to evaluate integrity. The following specific evaluation factors are provided:

- a. Review the design specifications, drawings and other documents to determine that proper design considerations were incorporated based on the intended use of the source.
- b. Review the methods of source construction and manufacture to ensure that the source was constructed in accordance with design and specifications.
- c. Where prototype testing has been performed or is determined to be necessary, review the testing results with regard to the intended use of the source.

- d. Ensure that proper labeling is incorporated on the source. As a minimum, the source must be labeled with the trefoil symbol and a unique serial number. When additional space is available, the labeling should follow the recommendations of NUREG-1556, Vol. 3.
- e. When sources have been tested in accordance with foreign standards, the standards should be compared to regulatory requirements and U.S. standards.
- f. Special requirements based on the proposed usage will be evaluated. These may include but not be limited to the following:
  - (1) Increased leak test requirements in addition to those required by our license.
  - (2) Special training and experience requirements.
  - (3) Special handling requirements and limitations on the use of the source.
  - (4) Consideration for radiation profiles, source installation, source servicing and specific user instructions.
- g. Additional guidance and information can be obtained from NUREG-1556, Vol. 3.

#### **A.4 Certification**

The Board will provide, to the principal investigator or project manager, a certificate that details the specific use of the source. The certificate will indicate that the source meets criteria necessary for the intended uses. Additional administrative requirements will be defined by the Board to include leak testing intervals and special handling requirements. The GSFC RSC will act as the final approving authority for these sources.

All certificates will be filed and maintained by the GSFC RPO.

#### **A.5 Reviews of Approved Sealed Sources**

The Board shall review records, including leak tests, reports of uses and other pertinent information once per year during the active use of each source. The Board shall review all reports of incidents and loss of integrity of sources that received certification by the Board within 30 days of receipt of the report. The RSC shall review all actions and reports of the Board and shall modify this process and procedure when appropriate. The RPO shall maintain records on all sources certified by the Board.

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## **APPENDIX B: Acronyms**

ALARA	As Low As Reasonably Achievable
GSFC	Goddard Space Flight Center
NRC	Nuclear Regulatory Commission
RPO	Radiation Protection Officer
RPDP	Radiation Protection Data and Procedures
RSC	Radiation Safety Committee
S&EB	Safety, Environmental and Security Office
SSRB	Sealed Source Review Board

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### CHANGE HISTORY LOG

Revision	Effective Date	Description of Changes
Baseline	06/02/03	Initial Release